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Studies on Costa Rican Odonata.

IV. *Erpetogomphus* in Costa Rica, with Descriptions of a New Species Having Complex Structural Mating Adaptations.

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(Plate XVII)

The following summary of the geographical distribution of the genus *Erpetogomphus* was published in 1905 (Calvert, 1901-1908, p. 159): "A very characteristic genus of the present [Mexican-Central American] fauna. Eleven species are now known, ten of which have actually been found in Mexico or Central America. The eleventh, *E. compositus*, is known from Texas and Arizona, and will doubtless be found in Mexico; it has been reported from the Yellowstone and Oregon, which, with Ohio and Indiana (*E. designatus*), are the most northern known limits of *Erpetogomphus*. To the south, Guatemala is at present the known limit; there is, however, a very doubtful record from Brazil."

In 1907, in the supplementary part of the same volume (p. 398), it was possible to say: "The most southern locality for this genus certainly known is now San José, in Costa Rica, as

cited below under *E. elaps*"—a single male taken by the late Professor Biolley, in May, 1905, now in the British Museum of Natural History as part of the Godman-Salvin collection.

During the year which I spent in Costa Rica, I only once saw an insect which I thought might have been an *Erpetogomphus*. This was on the southern edge of Cartago, but I was unable to capture it, and repeated visits to the same spot on subsequent days failed to rediscover it. Its identity is therefore entirely uncertain.

In July, 1911, Professor J. Fidel Tristán, Senora Tristán and Senor C. Picado, went to Oricuajo, a farm belonging to Senor Santiago Guell, on the Pacific side of Costa Rica, between the Rivers Machuca and Jesus Maria, where they unit. Professor and Senor Tristán were here from July 5-10, and made a collection of Odonata which Professor Tristán subsequently sent to me. Among them was a male and a female *Erpetogomphus*, enclosed in the same envelope, so presumably taken pairing. This pair not only confirm the existence of the genus in Costa Rica, but are of an undescribed species which, in honor of my friend and companion on many a delightful excursion, I herewith describe as

Erpetogomphus tristani, n. sp. (Plate XVII).

♂ Vertex, clypeus, labrum, occiput and genae dark brown. Frons bright green, except for a superior transverse dark brown stripe in front of the antennae which is confluent in front of each eye with a narrower transverse dark brown stripe along the inferior margin. Labium, maxillae and bases of the mandibles pale yellow, but the apices of all brown or black. A nearly straight transverse ridge on the vertex behind the ocelli, forming a tubercle bearing some long dark hairs behind each lateral ocellus, but concealing only a small part of the occiput when the head is viewed from in front (Fig. 2). Hind margin of the occiput almost straight, curving slightly upward at each eye, with a row of moderately long dark hairs.

Fore and hind lobes of the prothorax pale green, the former tinged with pale brown on the sides. Middle lobe pale brown, a pair of sub-median dorsal dots and a larger spot each side pale green.

Thorax (meso-metathorax) with the mid-dorsal carina, borders of the ante-alar sinus, a mid-dorsal and a humeral stripe, and stripes on the first and second lateral sutures and along the ventral margin of the metepimeron, dark maroon brown. The median brown stripe is

narrowed at the antealar sinus (where it is narrowly confluent with the upper end of the humeral stripe of each side) and still more so at the transverse anterior mesepisternal carina, in front of which it widens anteriorly and is confluent on the mesinfraepisterna with the lower end of each humeral stripe. The pale antehumeral stripe is bright green, is wider at both ends than at its middle, where it is about two-thirds as wide as the brown median stripe and half as wide as the brown humeral stripe at the same level. The brown humeral stripe is constricted to half its width at its upper end where, as well as at its lower end, it is narrowly confluent with the brown stripe of the first lateral suture. This latter is twice confluent in its uppermost fourth with the brown stripe of the second lateral suture, which in its turn is confluent above (very narrowly) and below with the metepimeral brown stripe. The pale color of the sides of the thorax is more yellowish than the pale antehumeral stripe and is wider in each of its three divisions than the brown stripe which bounds each division posteriorly. Inter-alar dorsal sclerites pale green. Pectus pale obscure yellowish.

Abdomen brown, darker on segments 3-8, marked with pale yellowish-green as follows: most of 1; the auricles and two (?) posterior spots, one lateral (the other dorsal?), on 2; a narrow mid-dorsal stripe or line beginning at the anterior end of each of segments 3-7 but not reaching the hind end of any of them; a spot on each side in the foremost fourth on 3 or sixth on 4-6 (or 7?). Segments 9 and 10 are of a more reddish-brown than those preceding and bear a greater number of delicate pale hairs.

Abdomen widest at segment 1 and again at the articulation of 9 and 10. A tuft of pale hairs on a brown spot at the hind margin of 1 where dorsal and lateral surfaces meet. Auricles on 2 well-developed, decidedly projecting, with about eight minute denticles on the posterior margin. Segments 7-9 successively shorter, 10 longer than 8 or 9 but shorter than 7. Hind margin of 9 angularly produced into a mid-dorsal posteriorly-directed process. The hind dorsal margin of 10 is rounded and produced into a small rounded median tubercle which fits between the superior appendages.

Genitalia of 2 (Fig. 9) black; anterior hamules shorter than the posterior, rounded and hooked at tip, posterior hamules tapering to the acute straight tips. Each of the two antero-lateral angles of the vesicle of the penis terminating in a lamellate process.

Superior appendages three-fifths as long as 10, pale green, blackish at extreme base and at apex, with many hairs half as long as, or longer than, each appendage is thick. In dorsal view (Fig. 6) almost straight and parallel, the posterior half of each obliquely truncated from the outer side inward (mesad) and backward (caudad); at two-

thirds length is a stout dorsal tooth on the inner (mesial) margin. In profile view (Fig. 5) each appendage at its base is almost half as high as the hind margin of 10 but contracts its height by one half on the ventral side of the proximal fifth; at one-half length is a strong tubercular ventral tooth directed ventrad, distad to this tooth the ventral edge is concave; the fourth sixth of the appendage's length on its dorsal edge is occupied by a stout tooth directed dorsad and caudad; from this tooth the thickness of the appendage gradually decreases to the apex which is obtuse and bent very slightly downward (ventrad). Viewed from below, each appendage has a ventral longitudinal carina in its proximal sixth and again in its distal half.

Inferior appendage shining blackish brown, its hairs fewer and shorter than those of the superiors. Viewed in profile (Figs. 5, 8), it does not quite attain the level of the inferior tooth of the superiors; it is curved strongly dorsad, then cephalad and finally, at its apex, ventrad, decreasing gradually in thickness throughout its length. Viewed from below (Fig. 7), its width decreases from the base; it is divided into two branches from almost the base, the branches closely appressed throughout and forming between them a deep ventral groove.

Femora dark brown, those of third legs redder, inner (lower) surface of first femora and a distal spot on inner surface of second pale green. Tibiae and tarsi black.

♀. Differs from the male as follows: Vertex with a deep median longitudinal groove on the posterior wall of which is situated the median ocellus; as a result, when the head is viewed from in front (Fig. 4), the median ocellus is above the level of the two lateral ocelli, and in dorsal view (Fig. 3) the median ocellus is completely posterior to the level of the other two. In the male, as in most Gomphinae, and indeed in Odonata generally, the median ocellus is below and at least not posterior to the level of the other two ocelli in these two views respectively (Figs. 2, 1). As a further result of the presence of this groove, the transverse ridge on the vertex behind the ocelli is produced in the middle dorsad and caudad as a marked convexity which conceals all of the occiput except its hind margin, when the head is viewed from in front. Dorsal surface of the occiput very much reduced antero-posteriorly, its hind margin strongly convex and fringed with dark hairs; posterior surface swollen in the middle, which is not the case in the male, and with a distinct socket on each side adjoining the compound eye. Front shallowly and widely grooved antero-posteriorly in the middle of its superior surface; this feature less marked in the male.

Mid-dorsal mesothoracic carina pale green; brown markings of the thorax paler, redder; green antehumeral stripe at mid-height half as wide as the brown mid-dorsal stripe.

Abdominal segment 2 with a mid-dorsal, and on each side a longitudinal, yellow stripe occupying the greater part of the length of the segment. Greatest width of the posterior half of the abdomen at the articulation of 8 and 9. Auricles on 2 very much smaller and not denticulated, as usual in this sex. Segments 7-10 successively shorter. Mid-dorsal posterior process of 9 shorter than in the male. Hind dorsal margin of 10 nearly straight, not produced. Eleventh segment a little shorter than the tenth, its tergite and sternites sub-equal. Terminal abdominal appendages as long as 10, pale brown, straight, conical, apices acute.

Vulvar lamina one-third as long as 9, its apical margin one-third as long as its base, shallowly concave (Fig. 10).

♂ ♀. Wings slightly smoky, tinged with faint yellow at the extreme base. Front wings with 14 (♂)-15 (♀) antenodals, 12-14 postnodals. Hind wings with 11 antenodals, 12-13 postnodals, anal triangle of ♂ 3-celled. Stigma dark brown.

Dimensions. Total length, ♂ 42, ♀ 44. Abdomen ♂ 31.5, ♀ 33.5. Hind wing, ♂ 28, ♀ 29. Costal edge of stigma, front wing ♂ 3, ♀ 3.5. Width of head ♂ 6, ♀ 6.3 mm.

Hab. Costa Rica, Oricuajo (Pacific side), July, 1911, by Prof. J. F. Tristán, 1 ♂, 1 ♀, now in the collection of the writer at the Academy of Natural Sciences of Philadelphia.

Type. The male above mentioned.

This pair show the following differences from the generic characters of *Erpetogomphus* as given in Biol. Centr.-Amer. Neur., pp. 146-147:

There are 9 (10 on the left side of the ♂) marginal cells on the front wings between M₄ and Cu₁ (short sector and first sector of the triangle) instead of 6-8 cells. I find in my notes, however, mention of a female *E. designatus* from Texas with 9-10 marginal cells.

There is but one row of cells in the anal and second cubital areas (postcostal area of de Selys) of the front wings from the base to beyond the level of the triangle; there are only two rows of cells at any point between Cu₂ (second sector of the triangle) and the hind margin in the male, but there are three rows for three (right) or four (left) cells in the female. These variations were met in the Biol. Cent. Amer. material also.

While the arculus is at or proximal to the second *subcostal* antenodal in seven out of the eight wings, it is not necessarily at or proximal to the level of the second *costal* antenodal, as the second subcostal antenodal is not coincident with the second costal antenodal in six out of the eight wings, but distal thereto. This lack of coincidence is often to be seen in this genus.

The sixth (instead of the fifth) antenodal is thicker on the left front wing of the female.

The abdomen of the male is widest at segment 9.

Erpetogomphus tristani ♂ falls under rubric AA of the key to the species of this genus (*Biol. Centr.-Amer. Neur.*, p. 160) so far as the superior appendages of the male are concerned, but the face has distinct dark markings. It is also allied to *E. ophibolus* of rubric A in possessing a superior tooth on the same appendages. In possessing both a superior and an inferior tooth, both well-developed, and such a strongly recurved inferior appendage, it differs* from all other described species of *Erpetogomphus*.

The female *tristani* falls under rubric BBB of the same key (*l. c.*, p. 162) and in its occipital characters and brown antehumeral (+ humeral) stripe comes nearer to *diadophis* than to *designatus*, but differs from these and all other known species by the peculiar structure of the vertex, which deserves fuller mention.

Mr. Williamson (1899) first pointed out that in the Odonata Anisoptera, in pairing, the inferior appendage of the male rests on the top of the head of the female and the superior appendages of the male on the rear of the head of the female. He was able (1906) to make positive observations to this effect in the genus *Gomphus*, among others. Calvert (1906), in confirmation, figured the two sexes of *Aeshna constricta* [= *umbrosa*, E. M. Walker] in this position. There is no reason to think that the mating position in *Erpetogomphus* is different. In the above description and in the figures (Figs. 3, 4) of the vertex of the head of *E. tristani* female, mention is made of a deep median longitudinal groove (*g*), and of the great reduction of the dorsal surface of the occiput. On placing the head of the female and the hind end of the male abdomen side by side in the same field of the microscope, it is evident that the recurved terminal part of the inferior appendage of the male (Fig. 8) is sufficiently narrow transversely to be received into the median vertical groove of the female. It seems inevitable that the inferior appendage should fit into this groove when pairing takes place. It is also likely that the ventral tooth of each

superior appendage of the male is received into the socket on each side of the posterior surface of the female's occiput, and that the dorsal tooth of the same appendage is braced against her prothorax. *E. tristani* therefore furnishes one of the most complex structural mating adaptations hitherto noticed in the Anisoptera. In looking over the plates of de Selys & Hagen (1858) nothing so complicated is to be found in any species of this family figured therein.*

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EXPLANATION OF PLATE XVII.

All the figures are of *Erpetogomphus tristani* n. sp. and have been drawn with the aid of the compound microscope and camera lucida. The magnification is the same in all, x 12.

Figs. 1 and 2. Dorsal and anterior views respectively of the vertex and occiput of the male. The dotted line in 1 shows the boundary between green and black on the superior surface of the frons.

Figs. 3 and 4. The same of the female. *g*, the vertical groove, *mo*, median ocellus.

Fig. 5. Left profile view of the apex of the male abdomen.

Fig. 6. Dorsal view of the superior abdominal appendages of the male.

Fig. 7. Ventral view of the inferior abdominal appendage of the male. Dotted lines show the proximal parts of the superior appendages.

Fig. 8. Left profile view of the inferior abdominal appendage of the male.

Fig. 9. Right profile view of the genitalia of the second and third abdominal segments of the male. *h*, posterior hamule and *s*, sheath of the penis, separated from the rest, *p* in lateral, *s* in posterior view.

Fig. 10. Ventral view of the 9th, and adjoining parts of the 8th and 10th, abdominal segments of the female.

*Since this paper was written, Dr. E. M. Walker's superb monograph of the North American Aeshnas has appeared (1912), in which he discusses (pp. 39-42) and figures (Plate 2) the copulatory position of *Aeshna*, *Gomphus* and other Odonata.